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## Description

This invention relates to a disposable linear surgical stapler, and more particularly to an improved linear surgical stapler for implanting staples into tissue.

In recent years an important medical trend has been the substitution of staples for conventional sutures in surgical procedures. Such staplers have simplified many procedures which were difficult to accomplish manually. Also, the use of surgical staplers has significantly reduced the time required for many procedures and thus reduced the time required for maintaining a patient under anesthetic.

Linear surgical staplers for implanting a row of staples have been in use for some time. One early linear stapler, such as that shown in U.S. Patent No. 3,080,564, included a permanent, rigid shaft, multi-use device wherein staples were manually loaded one-by-one. While such staplers performed well in a multiplicity of uses, they were complex in construction, expensive to manufacture, heavy, bulky, and difficult to load with staples. They also required continuous maintenance, cleaning and sterilizing after each use.

Improvements to such staplers included improved reloading features such as those shown in U.S. Patents Nos. 3,275,211 and 3,589,589. These improvements included the use of pre-sterilized, disposable loading units or staple cartridges. While these improvements significantly reduced the time previously required for hand-loading of the staples, the basic instrument still had to be disassembled, cleaned, reassembled, and sterilized for each procedure. These staplers also required frequent maintenance and adjustment.

Recently, rising hospital costs have generated an increasing interest in disposable surgical staplers. Disposable staplers are designed to eliminate as much work as possible (i.e., disassembly, cleaning, reassembly, sterilization, maintenance and adjustments), while not compromising surgical procedures, and improving overall efficiency.

One such disposable stapler is shown in U.S. Patent No. 4,383,634, for example. These staplers generally perform well. However, since the forward-most anvil-carrying jaw is pivoted, the anvil and cartridge may not approach each other in parallel relationship, making only a single gap setting achievable. Stated in another way, since the anvil and cartridge are pivoted at one end, there is only one position in which they are parallel to each other as they are pivoted. This permits only one gap setting for tissue as any other would produce a varying gap along the staple line due to a diverging orientation of anvil and cartridge. This in turn would result in staples having formed legs of varying length along the suture line.

To provide disposable staplers having differing gaps, manufacturers have simply supplied different staplers. Such staplers are frequently provided in a "tight" suturing version with short

legged staples, and a "loose" suturing version, with staples having longer legs. The surgeon selects the appropriate stapler for the particular procedure in process.

These aforementioned staplers have another difficulty inherently residing in their own rigid structures. While useful in many applications, it is often difficult to orient the stapler so as to implant a line of staples in exactly the right direction. Also, in some instances, it may be difficult to even apply the stapler to the tissue to be stapled in view of the tissue lying in limited access areas where it is difficult to place or maneuver the entire stapler.

Accordingly, it has been one objective of this invention to provide an improved disposable linear surgical stapler, overcoming one or more of the difficulties previously associated with disposable staplers.

US Patent No. 4 244 372 shows a surgical instrument for suturing organs comprising two pivotally connected parts, a staple — receiving part and a clinching part. A portion of an organ is clamped between jaws carried on these parts and then resected and sutured. Suturing is achieved by means of reciprocally acting bars which move through a path which causes them to engage staple drivers to sequentially fire a series of U-shaped staples. The structure of the stapler is rigid.

A disposable linear surgical stapler, in accordance with the invention comprises a handle, anvil means and staple cartridge means operatively connected to the anvil means, the anvil means and cartridge means selectively juxtaposed with respect to each other across a gap, first staple firing means on the handle and second staple firing means in the staple cartridge means, the staple firing means being operable to fire staples sequentially in a row characterised in that the handle is spaced from the anvil means and the staple cartridge means, in that a flexible means operably interconnects the staple firing means on the handle and the staple cartridge for driving staples from the cartridge and against the anvil across the gap (G) and in that the flexible means comprises a flexible conduit operatively connected at one end to the handle and at another end to the staple cartridge, and a flexible cable extending through the conduit, the flexible cable connected at one end to the first staple firing means and at another end to the second staple firing means, upon actuation of the first staple firing means, through the staple cartridge means to fire the staples.

A one-way rotatable firing knob may be provided on the handle and is connected through the cable to a firing wedge in the staple cartridge. The firing wedge is pulled along a line of staple drivers to sequentially fire staples toward the anvil, through the tissue to be sutured, and against the anvil.

The anvil advantageously includes a plurality of staple clinching pockets configured to form and

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clinch staples over the gap between the anvil and staple cartridge.

A one-way start apparatus is preferably utilized to prevent firing knob rotation in the wrong direction.

In order to insure proper anvil and staple cartridge alignment, the staple cartridge may be provided with an alignment pin and a latch lug, both of which are received and held in alignment receiving pockets within ends of the anvil apparatus. The latch lug is releasable to permit selective opening of the anvil and cartridge jaws.

Accordingly, it will be appreciated that the preferred embodiment of disposable linear surgical stapler can be utilized in limited access areas, the relatively small anvil and cartridge end being easily oriented in small area, while the handle remains outside such areas, and connected to the cartridge only by the cable and flexible conduit.

Moreover, the operation of the stapler is facilitated by sequential staple firing.

The stapler may also be useful in limited access areas and wherein an anvil and staple cartridge apparatus can be oriented in such area independently of, and spaced from, the position of the operating handle for the stapler.

The invention will now be described, by way of example with reference to the accompanying drawings in which:

Figure 1 shows a disposable linear surgical stapler in accordance with the invention, with the anvil and staple cartridge pivoted apart,

Figure 2 is an exploded perspective view of components of the stapler of Figure 1,

Figure 3 is a partially broken elevation view of the stapler of Figure 1, showing the anvil and cartridge latched together,

Figure 4 is a cross-sectional view taken along lines 4—4 of Figure 3,

Figure 5 is a cross-sectional view taken along lines 5—5 of Figure 3,

Figure 6 is an enlarged view of the staple driver of the stapler shown in Figure 1,

Figure 7 is a cross-sectional view taken along lines 7—7 of Figure 5,

Figure 8 is a cross-sectional view taken along lines 8—8 of Figure 7,

Figure 9 is a perspective view illustrating release of the anvil cartridge latch of the stapler of Figure 1,

Figure 10 is a perspective view illustrating tissue, such as an intestine, being placed in the stapler of Figure 1, the stapler being closed with one hand,

Figure 11 is a perspective view illustrating operation of the firing knob of the stapler of Figure 1 and

Figure 12 is a perspective view illustrating the excision of tissue from other closed tissue in the stapler of Figure 1.

Turning now to the drawings, there is shown in Figure 1 a disposable linear surgical stapler 10. The stapler 10 includes a handle 11, and elongated flexible shaft 12 and a cartridge/anvil structure 13, including a cartridge means 14 and an

anvil means 15 pivoted to each other at pivot point 16.

The stapler 10, is useful for Implanting two staggered rows of staples in tissue or organs such as those disposed in the alimentary canal or digestive tract. In general, and as will be further appreciated, the tissue is clamped in a gap G between the cartridge means 14 and the anvil means 15. A safety 17 in handle 11 is then retracted to the position shown in Figure 1, and firing knob 18 is rotated in the clockwise direction of arrows 19 in order to implant the staggered rows of staples in the tissue.

The utilization of the flexible shaft 12 permits the cartridge/anvil structure 13 to be oriented independent of the handle 11, with the flexible shaft operatively connecting the staple cartridge means 14 and the handle 11 for the implantation of staples, while removing the necessary apparatus of the handle 11 from immediately adjacent the tissue site in a surgical procedure.

#### Flexible Shaft

Referring now to Figs. 2 and 3, the flexible shaft 12 includes a flexible corrugated outer covering 25, a flexible conduit 26 and a flexible cable 27 slidably disposed within the conduit 26. Conduit 26 is preferably formed of spirally wrapped wire defining an open interior passageway.

Also included in the flexible shaft 12 is a flexible tension wire 28 preferably attached to the flexible conduit 26 along the length thereof. Tension wire 28, by virtue of its connection to the flexible conduit 26, prevents undesirable firing of the stapler due to inadvertent extensions of the flexible conduit 26.

Flexible tension wire 28 has a forward end 29 which is connected to the anvil/staple structure 13 and a rearward end 30 which is connected to the handle 11. The forward and rearward ends 29 and 30 of the flexible tension wire 28 are secured to the cartridge means 14 and the handle 11 respectively by any suitable means. Outer covering 25 serves as a flexible, sterilizable covering for the conduit 26 and provides a barrier between the metal conduit and surrounding tissues which otherwise might get pinched in the spring-wound conduit.

#### Staple Cartridge

Details of the various components and features of the stapler 10 are perhaps seen best in Figs. 2 and 3, with occasional reference to Figs. 4—8. Turning now to Fig. 2, various components of the stapler 10 are shown in exploded perspective form for the purposes of clarity of description. The cartridge/anvil structure 13 includes a cartridge means 14 and an anvil means 15.

The cartridge means 14 includes a cartridge body 35, a cartridge lid 36, and a cartridge support channel of housing 37. Cartridge support channel 37 is provided with lugs 38 and 39, defining a pivot line 16 about which the cartridge means 14 and anvil means 15 are pivoted together.

Within cartridge body 35 are disposed a plu-

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rality of staple drivers 40, the structure of which is best seen in Fig. 6. These drivers are substantially identical and for clarity will be referred to by the numeral 40 or by the numeral 40 followed by a letter where differentiation is necessary. Staple drivers 40 have lower bifurcated portions forming respective staple driving legs 41 and 42, which are offset with respect to each other. A top view of the drivers 40 as in Fig. 7 illustrates the offset nature of the respective legs of the drivers 40.

Each leg 41, 42 has a respective staple-engaging end 43, 44, and the legs 41 and 42 are joined at their upper ends, forming cam surfaces 45 and 46 which taper upwardly to form an apex 47 centrally of the driver 40. Driver leg 45 also includes an elongated guide rib 48, while leg 42 includes an elongated guide rib 49, which ribs extend downwardly from the respective cam surfaces 45 and 46. As will be appreciated, the respective driver legs 41 and 42 are operative to engage and fire staples in two offset or staggered rows. To this end, it will be further noted that leg 41 slightly overlaps leg 42. It will also be noted that actuation of a single driver 40 will be operable to drive two staples at the same time by means of legs 41 and 42 operating on a staple in each of the staggered rows.

Returning now to the cartridge means 14, it will be appreciated that the body 35 and the housing 37 are provided with respective projections and detents, such as those projections 51, 52 and 53, and respective detents 54, 55 and 56, for positioning and holding the housing 37 on the cartridge body 35 when the stapler is assembled. Moreover, it will be appreciated that the cartridge body 35 has a forward end 57 and a rearward end 58.

Also, it will be appreciated that cartridge body 35 is provided with a plurality of staple-ejecting apertures 59 making up one staple row, and staple ejecting apertures 60 making up a second, staggered staple row. Staple-ejecting apertures 59 lie in one row 61, while staple-ejecting apertures 60 lie in an adjacent, parallel but staggered row 62, the apertures 60 being staggered by approximately one-half staple width from the apertures 59 in the row 61. The rows 61, 62 in the preferred embodiment are about 60 millimeters in length, but it shall be appreciated that other size staplers according to the invention can be made, such as in staple row lengths of 90 millimeters and 120 millimeters, for example.

Turning now to further details of the cartridge means 14, attention is directed to Figs. 3, 5, 7 and 8. Fig. 7 is a partial cross-sectional view looking down into the cartridge body 35 from a position above the drivers 40 depicted in Fig. 7 as drivers 40, 40a and 40b, each of which is similar in construction.

The lefthand side of Fig. 7 corresponds generally to the forwardmost end 57 of the cartridge means 14 and includes a wedge pocket area 65. Tapered surfaces 66 and 67 define a rearward end of the wedge pocket 65 and serve as guiding surfaces as will be described.

The cartridge body 35 comprises elongated

side walls 68 and 69. A plurality of elongated vertical projections, or guide rails, 70 through 73 extend from the side wall 68 toward the opposite side wall, while an offset plurality of elongated rectangular projections 74 through 77 extend from the opposite side wall 69 toward the side wall 68. The guide rails are essentially identical, except the forwardmost guide rail 70a differs from the other guide rails in the provision of the tapered surface 66 adjacent wedge pocket 65. Guide rail 74a differs from the other guide rails by virtue of the tapering surface 67 at the rearward end of the wedge pocket 65.

The guide rails 70 through 77 are provided with curved driver guiding surfaces such as that shown at 78 in guide rail 74. These curved or concave surfaces extend longitudinally of the guide rails for reception of the guide ribs 48, 49 of the drivers 40. For example, as shown in Fig. 7, guide rib 48 extends into the concave guide surface 78, while the guide rib 49 of the same driver extends into the concave guide surface 78a of the guide rail 71.

The guide rails 70 through 77 are provided with elongated staple channels 80 for receiving staples "S" or "S-1" beneath the drivers. These staples preferably have legs about 4.0 to 5.0 millimeters in length and are formed of wire about .009" to .011" in diameter, although other sizes and shapes may also be useful. The staples S and S-1 are slightly wider than the respective driver legs, and thus ends of the staples S and S-1 are shown in the view of Fig. 7 extending outwardly from beneath the driver legs.

Each of the guide rails 70 through 77 include an upper tapered surface, such as at 81, which tapers from the respective side walls 68, 69 downwardly toward the bottom of the cartridge. At the right-hand edge of Fig. 7, the driver has not been shown in order to clearly illustrate the staples S and S-1 and their disposition within the cartridge body 35. It will also be appreciated that the respective guide rails 70 through 77 define driver receiving channels for reception of the respective drivers. For example, rails 71 and 72 define therebetween a portion of a driver receiving channel 82 for the leg 41 of the driver 40a, while the rails 75 and 76 define another offset portion of the same driver receiving channel for receiving the leg 42 of the driver 40a.

In Fig. 7 a single row 62 of staples S is shown at an upper portion of the figure, while another row 61 of staples, S-1, is shown at a lower portion of the figure. It will be appreciated then that the legs 41 of the respective drivers are disposed over a row 62 of staples S, while the respective legs 42 of the same drivers are disposed over a row 61 of staples S-1.

At the bottom of the driver channels 82, an elongated rib 83 is provided for closing off the bottom of the cartridge body 35 to prevent the drivers from falling out of the cartridge body 35.

Finally, it should further be noted that each rail includes a forward face 84 facing the opposite wall 68 and 69 of the cartridge body 35. These

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generally flat faces 84 surround the respective concave surfaces 78 and define a path "P" as will be further described.

In summary, then, the respective drivers 40 are slidably received within driver receiving channels 82, while the respective staples S and S—1, in their respective staggered rows, are received in the staple channels 80 beneath the drivers and in position for driving outwardly of the cartridge body 35 when the drivers are actuated against the staples.

A wedge 90 is disposed within the cartridge body 35, as will now be described. Wedge 90 includes a wedge blade 91 and a wedge base 92. Wedge blade 91 has a lower wedging surface 93 for engaging the cam surfaces 45 or 46 of the respective drivers 40 to drive them against the staples and fire the staples from the cartridge body 35.

Preferably, the wedge 90 is metallic and base 92 is crimped about the cable 27, as shown in Fig. 5. Alternately, of course, the wedge itself could be molded from any suitable material and attached to the cable 27 in any suitable manner.

Wedge 90 is originally disposed in the wedge pocket 65 at forward end 57 of the cartridge body 35. Guide surfaces 66 and 67 function to guide wedge blade 91 into path P, between rails 70—77 and are elongated in a direction normal to wedge movement.

The operation of the wedge surface 93 against the respective drivers is perhaps best seen in Fig. 3, where it can be appreciated that the wedge surface 93 has already engaged and pushed drivers 40c and 40d downwardly. Moreover, it will be appreciated that the surface 93 has further engaged drivers 40e, 40f and 40g and pushed them against the staples to varying extents. Driver 40h has not yet been contacted by the wedge surface 93.

In this regard, it will be further appreciated that the operation of the respective drivers, such as driver 40c for example, is operative to fire staples S (not shown in Fig. 3) and S—1 outwardly of the cartridge body 35 and against the anvil means 15 in two staggered rows. Only the row 62 of staples S is shown in Fig. 3. Thus, when driver 40c has been activated by the wedge 90, for example, a staple S is formed and clinched as shown in Fig. 3, and an offside staple S—1 (not shown) is also formed and clinched by operation of the driver 40c, and so on for each of the drivers in the cartridge body 35. Thus, a staple S—1 is fired simultaneously to a staple S in another row, however, the drivers are engaged sequentially so staples in the same row are fired, formed and clinched sequentially.

In order to capture the drivers 40 within the cartridge body 35, and in order to provide a guide for the wedge 90, cartridge lid 36 is disposed along the top of the cartridge as shown in Figs. 5 and 8. Cartridge lid 36 is provided with a slot 96 for receiving the blade 91 of the wedge 90. Furthermore, the lid 36 is provided with projections 97 and 98, for example, for securing the

cartridge lid 36 on the cartridge body 35 while also maintaining proper spacing between cartridge walls 68 and 69.

The housing 37 is disposed over the cartridge body 35 and serves to slidably capture the wedge 90 between the cartridge lid 36 and the housing 37 so that the wedge is free to slide through the slot 96 and within the path P (Figs. 5 and 7) in order to engage the respective drivers 40 to fire staples S and S—1.

It should be appreciated that the cartridge body 35, including walls 68, 69, rails 70—77 and rib 83 are preferably formed from an integral molding of any suitable material such as plastic.

#### Anvil

Returning now to Figs. 2 and 3, anvil means 15 will now be described in detail. The anvil means 15 comprises an anvil block 101 including an anvil insert 102 and an anvil 103 containing a series of staple pockets 104 for forming and clinching staples, such as shown in Fig. 3. Pockets 104 are shown in Fig. 1.

As mentioned above, the anvil 103 is adjustable in order to provide different sized gaps G. In particular, a sliding retention plate 105 is disposed between the insert 102 and a cam plate 106. A screw 107 captively secures the retention plate 105 and the cam plate 106 within an anvil support channel 110 by a threaded connection to a manually operable slide switch 111, while two screws 108 and 109 secure the slide plate 105 to the insert 102.

As best seen in Fig. 3, the cam plate 106 is provided with cam surfaces 112 and 113. Accordingly, and as shown in Fig. 3 for example, the anvil 103 can be extended outwardly of the anvil means 15 toward cartridge means 14 by sliding the retention plate 105 and the cam plate 106, as a unit. For example, and as shown in Fig. 3, the anvil 103 is in a retracted position. The heads of screws 108 and 109 reside on lower portions (as viewed in Fig. 3) of the respective cam surfaces 112 and 113. However, when slide switch 111 is engaged and moved to the right, as viewed in Fig. 3, it will be appreciated that the retention plate 105 and cam plate 106 also slide to the right and the heads of screws 108 and 109 ride up the respective cam surfaces 112 and 113 to a higher portion thereof, thereby extending the anvil 103 outwardly and toward the cartridge means 14.

Of course, it will be appreciated that the screws 108 and 109 extend through slots 114 and 115 respectively in the plate 105, while screw 107 secures together the plate 105, the cam plate 106 and the sliding switch 111. If desired, respective projections and detents can be provided in the mating faces of the plate 105 and cam plate 106 to prevent their movement with respect to each other.

It will also be appreciated that the position of the anvil 103 can be adjusted by means of adjusting the screws 108 and 109. For example, it is desirable to produce an anvil surface which is parallel to the cartridge means 14 when the anvil

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means 15 is latched to the cartridge means 14. Accordingly, and during manufacture of the invention, the screws 108 and 109 can be adjusted to a predetermined extension so that they produce, in combination with the cam plate 106, a parallel positioning of the anvil 103 with respect to both the entire anvil means 15 and the cartridge means 14.

Accordingly, it will be appreciated that the anvil means 15 provides an extensible anvil which is capable of defining at least two different gaps between the cartridge means 14 and the anvil means 15. A larger gap G is provided when the screws 108 and 109 reside in lower portions of the cam plate 106, and a smaller gap is produced when the cam plate 106 is moved so that the cam surfaces 112 and 113 engage the screws 109 and 108, respectively, to project the anvil outwardly of the anvil means 15, all while maintaining the anvil 103 in parallel relationship to the anvil means 15 and to the cartridge means 14, to provide a uniform gap G for whatever gap is selected.

Anvil means 15 is also provided with a cartridge means latch 120 mounted within the anvil support channel 110. The cartridge means latch 120 is perhaps best shown in Fig. 3 and includes a spring-loaded extensible latch member 121 urged by spring 122 in a forward direction, or to the left as viewed in Fig. 3, and against the stop which comprises a rivet 123. An actuating button 124 extends outwardly of the latch 120 and is manually operable to push the latch member 121 in a rearward direction, or to the right as viewed in Fig. 3, to unlatch the cartridge means 14, as will be described.

Of course, it is desirable to operably align the cartridge means 14 with the anvil means 15 and as well to latch the cartridge means 14 to the anvil means 15. In this regard, means are included for appropriately aligning, both longitudinally and laterally, the cartridge means 14 with the anvil means 15. As shown in Fig. 2, the cartridge body 35 is provided with a positioning lug 130 and a combination positioning and latching lug 131. Moreover, the anvil 103 is provided with positioning recesses 132 and 133 therein for receiving the respective lugs 130 and 131. Accordingly, when the cartridge means 14 and the anvil means 15 are pivoted together about pivot point 16, the lug 130 is received within the recess 132 and the combination positioning and latching lug 131 is received within the recess 133, the recess surfaces guiding and positioning the respective lugs, and thus maintaining the cartridge means 14 and anvil means 15 in aligned condition.

Also, it will be appreciated that the lug 131 includes a detent for engaging with an upper detent portion of the latch member 121 of the latch 120. As the lug 131 is received within the recess 133, it engages the latch member 121, pushes it rearwardly, and thereafter permits the latch member to move forwardly, holding the lug 131 within the anvil means 15 and thus latching the cartridge means 14 and the anvil means 15 together.

#### Handle

Turning now to Figs. 2, 3 and 4, the handle will now be described in detail. The handle 11 comprises right and left handle portions 140 and 141 secured together by appropriate peripheral lap joints, as shown at 142 in Fig. 4, and suitable hollow post and pin connection (not shown) respectively integral with the portions 140, 141.

The firing knob 18 is mounted externally of the handle portion 140 and has legs 146 extending therethrough for engagement with a cable pulley or spool 147. As shown in Fig. 4, spool 147 includes a depending shank 148 which is externally threaded. An internally threaded nut 149 is mounted on the shank 148. Nut 149 has a plurality of peripheral teeth 150 on the outer circumference thereof.

Handle portion 141 is provided with a circumferential array 151 of tooth receiving receptacles surrounding an upstanding post 152. When the right and left handle portions 140 and 141 are joined together, the shank 148 fits over the upstanding post 152 with the nut 149 residing on the shank 148 and the teeth 150 residing in the various receptacles of the array 151. Accordingly, when the firing knob 18 is turned, spool 147 and shank 148 also turn. Since the nut 149 is held against turning by virtue of the array 151, the nut translates or moves along the shank 148.

When the handle 11 is assembled, the nut 149 is originally placed on the shank 148 tightly against the bottom of the spool 147, as shown in Fig. 4. Accordingly, rotation of the firing knob 18 in a counterclockwise direction (as viewed in Fig. 1) is not possible since that direction of rotation would cause the nut 149 to move upwardly even more tightly against the spool 147. Since the nut 149 is restrained from rotating and engages the spool 147, the spool 147 comprises a stop means which impedes further movement of the nut 149 along the shank 148 toward the spool 147. Accordingly, it is impossible to initially rotate the firing knob 145 in an undesirable or inoperative direction. On the other hand, if the firing knob 18 is rotated in a clockwise direction, as shown in Fig. 1 in the direction of the arrow 19, the pulley 147 and the shank 148 are rotated, with the nut 149 moving downwardly toward the bottom of handle portion 141. The threads on the shank 148 are constructed so that the nut 149 reaches the bottom of the handle portion 141 just after the wedge has engaged all the drivers and all of the staples have been fired, formed and clinched, thus preventing further rotation of the firing knob 18 and signalling the stapling operation has been completed.

Of course, it will be appreciated that the spool 147 includes a receptacle means 155 for receiving the end 156 of the cable 27 such that when the spool 147 is rotated, the cable is wrapped around the spool, pulling the cable within the handle 11. It will also be appreciated that the flexible conduit 26 is secured within the receptacle 157 of handle 11 so that the conduit 26 cannot move within the handle 11. Thus the cable 27 is pulled through the conduit 26 upon rotation of knob 18 and spool

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147, thereby pulling the wedge 90 through path P in the cartridge body 35. Moreover, it will be appreciated that the forward end 29 of the flexible conduit 26 is provided with an adapter 158 for securing the conduit 26 to the cartridge means 14, and preventing the cartridge means 14 from being drawn toward handle 11.

Also it will be appreciated that when the firing knob 18 is rotated in a clockwise direction, the cable 27 wraps around pulley 147 and is pulled through the conduit 26, thus pulling the wedge 90 through the cartridge body 35. This causes the wedge surface 93 to sequentially engage the drivers 40 and fire the staples from the cartridge body 35 against the anvil 103 and through any tissue which is captured in the gap G between the cartridge means 14 and the anvil means 15.

Also provided within handle 11 is a safety for preventing any rotation of the firing knob 18 and the spool 147 until such is desired. This safety is perhaps best shown in Fig. 3 and comprises a safety lug 165 and a safety slide switch 166. Switch 166 is connected to the lug 165 for moving the lug forwardly and backwardly, in the direction of the arrow A as shown in Fig. 3. The spool 147 is provided with a depending circumferential flange 167 having a lug receiving recess or cut-out 168 slightly larger than safety lug 165. Accordingly, forward motion of switch 166 urges the lug 165 into the recess or cut out 168 in the flange 167, and prevents rotation of spool 147 in any direction. Accordingly, the stapler cannot be operated until the switch 166 is moved rearwardly, withdrawing the lug 165 from the spool 147. This prevents inadvertent firing of the stapler.

#### Operation

It will be appreciated that the stapler 10, according to a preferred embodiment of the invention, is manufactured and provided with a single load of staples S and S—1 disposed in the cartridge means 14 and in the two staggered rows 61, 62 as described, with the drives 40 poised on top of the respective staples S—1 and S.

Turning now to Figs. 9—12, it will be appreciated that the cartridge means 14 and the anvil means 15 may originally be secured together. When it is desired to utilize the stapler, the button 124 is manually depressed, as shown in Fig. 9, whereupon the cartridge means 14 and anvil means 15 can be pivoted to an open position. In this regard, a detent (not shown) may be provided in the anvil support channel for cooperating with a projection on the lugs 38 and 39 in order to maintain the anvil at about a 40° open relationship with respect to the cartridge means 14.

Thereafter, tissue such as intestinal tissue T, as shown in Fig. 10, is inserted between the cartridge means 14 and the anvil means 15. The cartridge means 14 and anvil means 15 are then pivoted about pivot point 16 until the latching lug 131 is received within the recess 133, and is latched by the latch 120.

The safety switch 166 is then moved rearwardly to unlock the spool 147 and the firing knob 18 is

rotated in a clockwise direction, as shown in Fig. 11, to pull the flexible cable 27 into the handle.

When the cable 27 is pulled toward the handle 11, it pulls the wedge 90 along the path P within the cartridge body 35, whereupon the wedge surface 93 engages the cam surfaces, such as surfaces 45 on the respective drivers 40. As each driver is engaged, it progressively fires a staple S and a staple S—1 across the gap G between the cartridge means 14 and the anvil means 15 though any tissue T therebetween and against the anvil 103 for forming and clinching the staples S and S—1. It will be appreciated that the staple driving is accomplished in a sequential fashion and while each driver drives two staples, all staples are not driven simultaneously but rather sequentially as the wedge 90 is moved through the path P to sequentially engage the respective drivers 40. Thus, all drivers are not simultaneously operated and firing force is reduced as compared to the force which may be necessary to simultaneously fire, implant, form and clinch all staples S and S—1.

Once the safety switch 166 has been moved rearwardly, the spool 147 would ordinarily be free for rotation in either direction. Thus it would be possible to rotate the firing knob in an undesirable counterclockwise direction. The proper initial rotation direction, however, is assured by the travelling nut 149, since a resistance is encountered in turning the firing knob 18 in a counterclockwise direction due to the engagement of the nut 149 against the bottom of the spool 147. Accordingly, only proper clockwise direction is permitted in order that the spool 147 is properly rotated to pull the cable 27 and thus the wedge in order to fire the staples S and S—1.

After the stapler 10 has been fired, and all staples S and S—1 implanted, formed and clinched in tissue T, the tissue can be excised by use of a scalpel as shown in Fig. 12. The cartridge means 14, anvil means 15, or both, can be used as a scalpel guide insuring that no excision is made too close to the implanted staples.

Thereafter, button 124 is pinched to release the forward end 57 of cartridge means 14 from anvil means 15. The cartridge means 14 and anvil means 15 are then pivoted apart to release the closed tissue.

It will be thus appreciated that the stapler has many advantages. For example, the handle 11 can be provided independently of the cartridge means 14 and anvil means 15, thus permitting the utilization of the stapler 10 in very limited access areas where the handle 11 can remain spaced from the area. It is only necessary to maneuver the cartridge and anvil structure into the area for utilization with particular tissue. Also it will be appreciated that since the cartridge means 14 and anvil means 15 can be essentially operated with one hand, further access and utility in limited access areas is facilitated.

Also, it will be appreciated that the cam adjustment means as described herein with respect to the anvil means 15 provides for a disposable,



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linear, flexible surgical stapler 10 having at least two different gap settings, so that different types and sizes of tissue can be accommodated; all while the anvil means 14 and cartridge means 15 are maintained in a parallel relationship. Accordingly, single size staples can be utilized for variable gap settings and it is not necessary, within the operating range of the apparatus 10, to provide different size staples, or staplers pre-loaded with different size staples.

It will also be appreciated that the structure of the flexible stapler 10, provides for the utilisation of optimum materials. For example, the cartridge housing 37 can be manufactured of metallic material while remaining portions of the cartridge means 14 can be manufactured from plastic materials, at reduced expense, with greater manufacturing ease, and no sacrifice in strength or efficiency.

Also it will be appreciated that the position lug 130 and the position and latch lug 131 can also be manufactured from any suitable materials and as well serve to maintain the cartridge means 14 and the anvil means 15 in proper longitudinal and lateral position with respect to each other during a stapling procedure.

It should be appreciated that the structure of the drivers 40 provides the advantage of a single driver serving to fire staples in two staggered staple rows. The driver 40 is also reversible so that it fits into the driver channel 82 regardless of which leg 41 or 42 is oriented forwardly and which rearwardly. This universality is provided in part by the double cam surfaces 45, 46.

Moreover, it will be appreciated that the construction of the cartridge body means 14, drivers 40, wedge 90, handle 11, shaft 12, and the anvil means 15, all as described, might be modified, yet still produce the results as described herein.

#### Claims

1. A disposable linear surgical stapler comprising a handle, anvil means and staple cartridge means operatively connected to the anvil means, the anvil means and cartridge means selectively juxtaposed with respect to each other across a gap, first staple firing means on the handle and second staple firing means in the staple cartridge means, the staple firing means being operable to fire staples sequentially in a row characterised in that the handle (11) is spaced from the anvil means (15) and the staple cartridge means (14), in that a flexible means (12) operably interconnects the staple firing means (18) on the handle and the staple cartridge (14) for driving staples (5) from the cartridge and against the anvil across the gap (G) and in that the flexible means comprises a flexible conduit (26) operatively connected at one end to the handle (1) and at another end to the staple cartridge, and a flexible cable (27) extending through the conduit (26), the flexible cable (27) connected at one end to the first staple firing means (18) and at another end to the second staple firing means (90) for pulling the second

staple firing means (90), upon actuation of the first staple firing means, (18) through the staple cartridge means (14) to fire the staples.

2. A disposable linear surgical stapler as claimed in claim 1 wherein the stapler is operable to implant and form at least one row of staples in tissue and wherein the staple cartridge means (14) includes a cartridge body (35), a plurality of paired staple channels (80) in the body for holding staples in a row and a plurality of staple drivers (40) operatively aligned with respective staples in the staple channels (80).

3. A disposable linear surgical stapler as claimed in claim 2 wherein the second staple firing means (90) comprises a wedge means movable through a path in which the drivers (40) lie for engaging and moving the drivers to sequentially fire the staples.

4. A disposable linear surgical stapler as claimed in claim 3 wherein the flexible cable (27) has one end attached to the wedge means and another end attached to the first staple firing means (18), and wherein the first staple firing means comprises means for applying tension to the cable for pulling the wedge through the path and firing the staples towards the anvil means (15).

5. A disposable linear surgical stapler as claimed in claim 4 wherein the first staple firing means (18) comprises a rotatable firing knob means, the flexible cable being attached to the firing knob means such that rotation of the firing knob means pulls the cable and the wedge is thereby pulled from its initial position, at one end of the staple cartridge means, slidably through the path toward the other end of the staple cartridge means.

6. A disposable linear surgical stapler as claimed in claim 5, wherein the flexible conduit (26) has two ends (29, 30) one secured to the handle and one to the cartridge means, such that when the knob means (18) is operated, the cable (27) slides within the conduit and is operative to draw the wedge means (90) within the cartridge means from a forward to a rearward end thereof and toward the handle.

7. A disposable linear surgical stapler as claimed in any preceding claim wherein the anvil means (15) comprises an anvil having a plurality of staple pockets (104) for forming and clinching staples.

8. A disposable linear surgical stapler as claimed in any preceding claim wherein the anvil means and the cartridge means are pivoted together at a pivot point near the rearward ends thereof, the anvil including cartridge means positioning receptacles (132, 133) at each end thereof for receiving cartridge positioning and latching projections (130, 131) for positioning the cartridge means with respect to the anvil.

9. A disposable linear surgical stapler, as claimed in any one of claims 3 to 8 wherein the stapler is operable to implant and form two staggered rows of staples in tissue and further including a plurality of staggered guide rails



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(70—77) within the cartridge means and defining driver channels (82) for guiding the staple drivers (40) as they are moved by the wedge means (90) to fire staples, the staggered guide rails also defining inwardly facing guide surfaces (78) for guiding the wedge means along the drive path.

10. A disposable linear surgical stapler, as claimed in any one of claims 3 to 9 further including a wedge means pocket (65) disposed at a forward end of the cartridge means for receiving the wedge means prior to movement thereof along the path.

11. A disposable linear surgical stapler, as claimed in claim 10 wherein guide rails at a forward end of the path within the cartridge means have respective forward tapering surfaces (66, 67) leading from the wedge means pocket (65) to the path for guiding the wedge therebetween when the wedge is pulled toward the drivers.

12. A disposable linear surgical stapler, as claimed in any one of claims 2 to 11 wherein each of the drivers (40) comprises bifurcated, offset, staple driving leg portions (41, 42) joined at upper ends thereof, each upper end having a cam surface (45, 46) sloping upwardly to an apex (47) intermediate the leg portions.

13. A disposable linear surgical stapler, as claimed in claim 12 wherein one of the leg portions (41) of each driver resides between two guide rails (70—73) on one side of the cartridge means, and the other leg portion (42) of each driver resides between another two guide rails (74—77) on another side of the cartridge means offset from the other pair of guide rails (70—73).

14. A disposable linear surgical stapler, as claimed in any one of claims 3 to 13 including an elongated driver blocking rib (83) extending between staple rows at a bottom face of the cartridge means for blocking free movement of drivers (40) out of the cartridge means.

15. A disposable linear surgical stapler, as claimed in any one of claims 3 to 14 including a cartridge lid (36) disposed over the driver channels and capturing the drivers (40) therein, the lid defining an elongated slot (96) aligned with the path for guiding the wedge means (90).

16. A disposable linear surgical stapler, as claimed in claim 15 wherein the wedge means (90) includes a tapered wedge blade (91) extending in the path and a base member (92) slidably disposed on the cartridge lid (36).

17. A disposable linear surgical stapler, as claimed in claim 16 wherein the cartridge means includes a cartridge body (35) housing staple channels, guide rails, drivers and wedge pocket, and further including a cartridge housing (37) enclosing the base member (92) of the wedge means and slidably holding the base member on the cartridge lid (36).

18. A disposable linear surgical stapler as claimed in any preceding claim wherein a flexible reinforcing means (28) attached along the flexible means (12) for preventing firing of the

staples in response to inadvertent elongation of the flexible means.

19. A disposable linear surgical stapler as claimed in any one of claims 5 to 18 wherein the firing knob means comprises a knob (18), a cable spool (147) attached to the knob (18) for rotation therewith and operable to pull the cable (27) when initially rotated in a predetermined direction and means for preventing initial rotation of the spool in an inoperative direction other than the predetermined direction.

20. A disposable linear surgical stapler as claimed in claim 19 wherein the firing knob means further comprises a threaded shank (148) extending beyond the spool for rotation therewith, a nut (149) on the threaded shank, means (151) for restraining the nut from rotation, such that when the knob is turned the nut moves along the shank, and first stop means (147) for engaging the nut and holding it against movement along the shank, and preventing rotation of the knob in an inoperative direction when the knob is initially rotated.

21. A disposable linear surgical stapler as claimed in claim 20 further including a second stop surface for preventing continued rotation of the shank, spool and knob when a number of staples have been fired.

22. A disposable linear surgical stapler as claimed in either of claims 20 or 21 further including slidable safety lug means (165, 168) for engaging one of the knob, spool and shank and selectively preventing rotation thereof.

23. A disposable linear surgical stapler as claimed in claim 22 wherein the spool means is provided with a safety lug recess (168) and further including a slidable safety lug (165) within the handle for extending into the safety lug recess in a safety position preventing rotation of the knob, and being slidable out of the safety lug recess to permit rotation of the knob.

#### Patentansprüche

1. Geradliniges, chirurgisches Einweg-Klammergerät, umfassend einen Handgriff, eine Anschlagvorrichtung und eine Klammernpatronenvorrichtung, die in betriebswirksamer Weise mit der Anschlagvorrichtung verbunden ist, wobei die Anschlagvorrichtung und die Patronenvorrichtung im Verhältnis zueinander über einen Spalt wahlweise nebeneinander angeordnet werden können, eine erste Klammernausstoßvorrichtung am Handgriff und eine zweite Klammernausstoßvorrichtung in der Klammernpatronenvorrichtung, wobei die Klammernausstoßvorrichtung dazu dient, Klammern nacheinander in Form einer Reihe auszuwerfen, dadurch gekennzeichnet, daß der Handgriff (11) mit Abstand zur Anschlagvorrichtung (15) und zur Klammernpatronenvorrichtung (14) angeordnet ist, daß eine flexible Vorrichtung (12) in betriebswirksamer Weise die Klammernausstoßvorrichtung (18) am Handgriff und die Klammernpatrone (14) miteinander verbindet,

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um so Klammern (5) aus der Patrone und gegen den Anschlag über den Spalt (G) ausstoßen zu können, und daß die flexible Vorrichtung eine flexible Hülle (26), die in betriebswirksamer Weise an einem Ende am Handgriff (11) und an einem anderen Ende mit der Klammernpatrone verbunden ist, sowie ein flexibles Kabel (27) umfaßt, das durch die Hülle (26) verläuft, wobei das flexible Kabel (27) an einem Ende mit der ersten Klammernausstoßvorrichtung (18) und an einem anderen Ende mit der zweiten Klammernausstoßvorrichtung (90) verbunden ist, um so die zweite Klammernausstoßvorrichtung (90), wenn die erste Klammernausstoßvorrichtung (18) betätigt wird, durch die Klammernpatronenvorrichtung (14) ziehen zu können, damit die Klammern ausgestoßen werden.

2. Geradliniges, chirurgisches Einweg-Klammergerät gemäß Anspruch 1, wobei sich das Klammergerät so betätigen läßt, daß zumindest eine Klammernreihe in Gewebe implantiert und eingebracht werden kann, und wobei die Klammernpatronenvorrichtung (14) einen Patronenkörper (35), im Körper eine Vielzahl paarweise angeordneter Klammernkanäle (80) zur Halterung der Klammern in Reihenform sowie eine Vielzahl von Klammertreibelementen (40) umfaßt, die in betriebswirksamer Weise im Verhältnis zu entsprechenden Klammern in den Klammernkanälen (80) ausgerichtet sind.

3. Geradliniges, chirurgisches Einweg-Klammergerät gemäß Anspruch 2, wobei die zweite Klammernausstoßvorrichtung (90) eine Keilvorrichtung umfaßt, die über eine Führung bewegbar ist, in der die Treibelemente (40) angeordnet sind, um so einen Eingriff mit den Treibelementen herzustellen und diese zu bewegen, damit so die Klammern nacheinander ausgestoßen werden können.

4. Geradliniges, chirurgisches Einweg-Klammergerät gemäß Anspruch 3, wobei das flexible Kabel (27) mit einem Ende an der Keilvorrichtung und mit einem anderen Ende an der ersten Klammernausstoßvorrichtung (18) befestigt ist, und wobei die erste Klammernausstoßvorrichtung eine Vorrichtung umfaßt, mit deren Hilfe das Kabel unter Spannung gesetzt werden kann, um so den Keil durch die Führung ziehen und die Klammern in Richtung auf die Anschlagvorrichtung (15) ausstoßen zu können.

5. Geradliniges, chirurgisches Einweg-Klammergerät gemäß Anspruch 4, wobei die erste Klammernausstoßvorrichtung (18) eine drehbare Ausstoßknopfvorrichtung umfaßt, wobei das flexible Kabel so an der Ausstoßknopfvorrichtung befestigt ist, daß durch die Drehung der Ausstoßknopfvorrichtung eine Zugkraft auf das Kabel einwirkt und der Keil dadurch aus seiner Anfangsposition, die sich an einem Ende der Klammernpatronenvorrichtung befindet, in gleitender Weise durch die Führung in Richtung auf das andere Ende der Klammernpatronenvorrichtung gezogen wird.

6. Geradliniges, chirurgisches Einweg-Klammergerät gemäß Anspruch 5, wobei die flexible

Hülle (26) zwei Enden (29, 30) besitzt, wobei ein Ende davon am Handgriff und das andere Ende an der Patronenvorrichtung so befestigt ist, daß, wenn die Knopfvorrichtung (18) betätigt wird, das Kabel (27) innerhalb der Hülle eine gleitende Bewegung durchführt und somit in betriebswirksamer Weise dazu in der Lage ist, die Keilvorrichtung (90) innerhalb der Patronenvorrichtung von einem vorderen Ende zu einem hinteren Ende davon und in Richtung auf den Handgriff zu ziehen.

7. Geradliniges, chirurgisches Einweg-Klammergerät gemäß irgendeinem der vorstehenden Ansprüche, wobei die Anschlagvorrichtung (15) einen Anschlag mit einer Vielzahl von Klammertaschen (104) umfaßt, um so die Klammern formen und stauchen zu können.

8. Geradliniges, chirurgisches Einweg-Klammergerät gemäß irgendeinem der vorstehenden Ansprüche, wobei die Anschlagvorrichtung und die Patronenvorrichtung in schwenkbarer Ausführung an einem Punkt in der Nähe ihrer hinteren Enden miteinander verbunden sind, wobei der Anschlag Patronenvorrichtungsjustiersitze (132, 133) an jedem Ende umfaßt, die dazu dienen, die Patronenjustier- und -einrastvorsprünge (130, 131) zur Positionierung der Patronenvorrichtung im Verhältnis zum Anschlag aufzunehmen.

9. Geradliniges, chirurgisches Einweg-Klammergerät gemäß irgendeinem der Ansprüche 3 bis 8, wobei das Klammergerät in betriebswirksamer Weise dazu dient, zwei versetzt angeordnete Klammernreihen in Gewebe zu implantieren und einzubringen, und weiterhin umfassend eine Vielzahl versetzt angeordneter Führungsschienen (70—77) innerhalb der Patronenvorrichtung, wobei Treibelementkanäle (82) definiert sind, die dazu dienen, die Klammertreibelemente (40) zu führen, wenn diese mit Hilfe der Keilvorrichtung (90) zwecks Klammernausstoß bewegt werden, wobei die versetzt angeordneten Führungsschienen ebenfalls nach innen gerichtete Führungsflächen (78) definieren, die dazu dienen, die Keilvorrichtung an der Führung entlang zu führen.

10. Geradliniges, chirurgisches Einweg-Klammergerät gemäß irgendeinem der Ansprüche 3 bis 9, weiterhin umfassend eine Keilvorrichtungstasche (65), die an einem vorderen Ende der Patronenvorrichtung angeordnet ist, um die Keilvorrichtung vor ihrer Bewegung an der Führung entlang aufzunehmen.

11. Geradliniges, chirurgisches Einweg-Klammergerät gemäß Anspruch 10, wobei die Führungsschienen an einem vorderen Ende der Führung innerhalb der Patronenvorrichtung entsprechende vordere konische Flächen (66, 67) aufweisen, die von der Keilvorrichtungstasche (65) bis zur Führung verlaufen, um so den dazwischen angeordneten Keil zu führen, wenn der Keil in Richtung auf die Treibelemente gezogen wird.

12. Geradliniges, chirurgisches Einweg-Klammergerät gemäß irgendeinem der Ansprüche 2 bis 11, wobei jedes der Treibelemente (40) gabelförmig ausgebildete, versetzte, klammertreib-

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bende Schenkelabschnitte (41, 42) umfaßt, die an ihren oberen Enden verbunden sind, wobei jedes obere Ende eine Nockenfläche (45, 46) aufweist, die sich mit einer Neigung nach oben bis zu einem Scheitelpunkt (47) zwischen den Schenkelabschnitten erstreckt.

13. Geradliniges, chirurgisches Einweg-Klammergerät gemäß Anspruch 12, wobei einer der Schenkelabschnitte (41) eines jeden Treibelements zwischen zwei Führungsschienen (70—73) an einer Seite der Patronenvorrichtung angeordnet ist, und wobei der andere Schenkelabschnitt (42) eines jeden Treibelements zwischen zwei anderen Führungsschienen (74—77) an einer anderen Seite der Patronenvorrichtung versetzt zum anderen Paar der Führungsschienen (70—73) angeordnet ist.

14. Geradliniges, chirurgisches Einweg-Klammergerät gemäß irgendeinem der Ansprüche 3 bis 13, umfassend eine länglich ausgeführte Treibelementblockierrippe (83), die zwischen Stapelreihen an einer unteren Stirnfläche der Patronenvorrichtung verläuft, um eine freie Bewegung der Treibelemente (40) aus der Patronenvorrichtung heraus zu blockieren.

15. Geradliniges, chirurgisches Einweg-Klammergerät gemäß irgendeinem der Ansprüche 3 bis 14, umfassend eine Patronenabdeckung (36), die über den Treibelementkanälen angeordnet ist und die Treibelemente (40) darin festhält, wobei die Abdeckung einen länglich ausgeführten Schlitz (96) definiert, der im Verhältnis zur Führung der Keilvorrichtung (90) entsprechend ausgerichtet ist.

16. Geradliniges, chirurgisches Einweg-Klammergerät gemäß Anspruch 15, wobei die Keilvorrichtung (90) ein konisch ausgeführtes Keilblatt (91), das in der Führung verläuft, und ein Basiselement (92) umfaßt, das in gleitender Ausführung an der Patronenabdeckung (36) angeordnet ist.

17. Geradliniges, chirurgisches Einweg-Klammergerät gemäß Anspruch 16, wobei die Patronenvorrichtung einen Patronenkörper (35) umfaßt, in dem die Klammernkanäle, Führungsschienen, Treibelemente und Keiltaschen untergebracht sind, und weiterhin umfassend ein Patronengehäuse (37), das das Basiselement (92) der Keilvorrichtung umgibt und in gleitender Ausführung für die Befestigung des Basiselements an der Patronenabdeckung (36) sorgt.

18. Geradliniges, chirurgisches Einweg-Klammergerät gemäß irgendeinem der vorstehenden Ansprüche, wobei eine flexible Verstärkungs- vorrichtung (28) an der flexiblen Vorrichtung (12) entlang befestigt ist, um einen Klammernausschlag als Reaktion auf eine unbeabsichtigte Längung der flexiblen Vorrichtung zu unterbinden.

19. Geradliniges, chirurgisches Einweg-Klammergerät gemäß irgendeinem der Ansprüche 5 bis 18, wobei die Ausstoßknopfvorrichtung einen Knopf (18), eine Kabelrolle (147), die zwecks gemeinsamer Drehung am Knopf (18) befestigt ist und in betriebswirksamer Weise dazu dient, das Kabel (27) bei anfänglicher Drehung in vorbestimmter Richtung zu ziehen, und eine Vorrich-

tung umfaßt, mit deren Hilfe eine anfängliche Drehung der Rolle in nicht betriebswirksamer Richtung, d. h. entgegen der vorbestimmten Richtung, unterbunden wird.

20. Geradliniges, chirurgisches Einweg-Klammergerät gemäß Anspruch 19, wobei die Ausstoßknopfvorrichtung weiterhin einen Gewindeschacht (148), der über die Rolle hinausragt und zwecks gemeinsamer Drehung vorgesehen ist, eine Mutter (149) am Gewindeschacht, eine Vorrichtung (151), die eine Drehbewegung der Mutter unterbindet, so daß sich, wenn der Knopf gedreht wird, die Mutter am Schaft entlang bewegt, und eine erste Arretiervorrichtung (147) umfaßt, die in die Mutter eingreift und sie so hält, daß eine Bewegung am Schaft entlang unterbleibt, um dadurch eine Drehung des Knopfes in nicht betriebswirksamer Richtung dann zu vermeiden, wenn der Knopf anfänglich gedreht wird.

21. Geradliniges, chirurgisches Einweg-Klammergerät gemäß Anspruch 20, weiterhin umfassend eine zweite Arretierfläche, um eine fortgesetzte Drehung des Schafts, der Rolle und des Knopfes zu unterbinden, wenn eine Anzahl von Klammern ausgestoßen worden sind.

22. Geradliniges, chirurgisches Einweg-Klammergerät gemäß Anspruch 20 oder Anspruch 21, weiterhin umfassend in gleitender Ausführung vorgesehene Sicherheitsansatzvorrichtungen (165, 168) die jeweils in den Knopf, die Rolle und den Schaft eingreifen, um so wahlweise eine Drehung zu verhindern.

23. Geradliniges, chirurgisches Einweg-Klammergerät gemäß Anspruch 22, wobei die Rollen- vorrichtung mit einem Sicherheitsansatz- rücksprung (168) versehen ist, und weiterhin umfassend einen in gleitender Ausführung vorgesehenen Sicherheitsansatz (165) innerhalb des Handgriffs, der in einer Sicherheitsposition in den Sicherheitsansatzrücksprung eingreift, um so eine Drehung des Knopfes zu verhindern, und der sich in gleitender Weise aus dem Sicherheitsansatzrücksprung zurückziehen kann, um so eine Drehung des Knopfes zu ermöglichen.

## Revendications

1. Appareil jetable pour la pose d'agrafes de sutures linéaires comprenant une poignée, un dispositif à enclume et un dispositif à cartouche d'agrafes relié opérativement au dispositif à enclume, le dispositif à enclume et le dispositif à cartouche étant sélectivement juxtaposés l'un à l'autre de part et d'autre d'un intervalle, un premier dispositif de déclenchement d'agrafage sur la poignée et un second dispositif de déclenchement d'agrafage dans le dispositif à cartouche d'agrafes, les dispositifs, de déclenchement pouvant être actionnés pour déclencher la pose d'agrafes séquentiellement en une rangée, caractérisé en ce que la poignée (11) est espacée du dispositif à enclume (15) et du dispositif à cartouche d'agrafes (14), en ce qu'un dispositif flexible (12) relie opérativement le dispositif de déclenchement d'agrafage (18) de la poignée et le

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dispositif à cartouche d'agrafes (14) pour chasser des agrafes (5) hors de la cartouche contre l'enclume à travers l'intervalle (G) et en ce que le dispositif flexible comprend un conduit flexible (26) relié opérativement, à une extrémité, à la poignée (11) et, à une autre extrémité, à la cartouche d'agrafes, et un câble flexible (27) qui s'étend dans le conduit (26) et qui est relié, à une extrémité, au premier dispositif de déclenchement d'agrafage (18) et, à une autre extrémité, au second dispositif de déclenchement d'agrafage (90), pour tirer le second dispositif de déclenchement d'agrafage (90) à travers le dispositif à cartouche d'agrafes (14), lorsque le premier dispositif de déclenchement d'agrafage est actionné, afin de chasser les agrafes.

2. Appareil jetable pour la pose d'agrafes de sutures linéaires suivant la revendication 1, qui peut être actionné pour implanter et former au moins une rangée d'agrafes dans des tissus et dans lequel le dispositif à cartouche d'agrafes (14) comprend un corps de cartouche (35), plusieurs canaux à agrafes (80) disposés par paires dans le corps pour retenir des agrafes en une rangée et plusieurs chasse-agrafes (40) opérativement alignés avec des agrafes respectives dans les canaux à agrafes (80).

3. Appareil jetable pour la pose d'agrafes de sutures linéaires suivant la revendication 2, dans lequel le second dispositif de déclenchement d'agrafage (90) comprend un coin mobile suivant un trajet dans lequel sont situés les chasse-agrafes (40) afin d'attaquer et de déplacer ces chasse-agrafes pour chasser séquentiellement les agrafes.

4. Appareil jetable pour la pose d'agrafes de sutures linéaires suivant la revendication 3, dans lequel une extrémité du câble flexible (27) est attachée au coin et une autre extrémité est attachée au premier dispositif de déclenchement d'agrafage (18) dans lequel ce premier dispositif de déclenchement d'agrafage comprend un moyen pour exercer une traction sur le câble afin de tirer le coin suivant le dit trajet et de chasser les agrafes vers le dispositif à enclume (15).

5. Appareil jetable pour la pose d'agrafes de sutures linéaires suivant la revendication 4, dans lequel le premier dispositif de déclenchement d'agrafage (18) comprend un bouton de déclenchement tournant, le câble flexible étant attaché au bouton de déclenchement d'une manière telle que la rotation de ce bouton de déclenchement exerce une traction sur le câble et que le coin soit ainsi tiré à partir de sa position initiale, à une extrémité du dispositif à cartouche d'agrafes, à coulissement suivant le dit trajet vers l'autre extrémité du dispositif à cartouche d'agrafes.

6. Appareil jetable pour la pose d'agrafes de sutures linéaires suivant la revendication 1, dans lequel le conduit flexible (26) comporte deux extrémités (29, 30) dont l'une est fixée à la poignée et l'autre, au dispositif à cartouche, de sorte que lorsque le bouton (18) est actionné, le câble (27) glisse dans le conduit et est à même de tirer le coin (90) dans le dispositif à cartouche

depuis une extrémité antérieure vers une extrémité postérieure de celui-ci, en direction de la poignée.

7. Appareil jetable pour la pose d'agrafes de sutures linéaires suivant l'une quelconque des revendications précédentes, dans lequel le dispositif à enclume (15) comprend une enclume comportant plusieurs loges à agrafes (104) pour former et river des agrafes.

8. Appareil jetable pour la pose d'agrafes de sutures linéaires suivant l'une quelconque des revendications précédentes, dans lequel le dispositif à enclume et le dispositif à cartouche sont articulés l'un à l'autre à un pont de pivotement situé près de leurs extrémités postérieures, l'enclume comprenant des ouvertures de positionnement (132, 133) pour le dispositif à cartouche, à chaque extrémité, pour recevoir des saillies de positionnement et de verrouillage de cartouche (130, 131) en vue de positionner le dispositif à cartouche par rapport à l'enclume.

9. Appareil jetable pour la pose d'agrafes de sutures linéaires suivant l'une quelconque des revendications 3 à 8, qui peut être actionné pour implanter et former deux rangées d'agrafes disposées en quinconce dans du tissu et comprend, en outre, plusieurs rails de guidage décalés en quinconce (70—77) dans le dispositif à cartouche et définissant des rainures (82) destinées à guider les chasse-agrafes (40) lorsqu'ils sont déplacés par le coin (90) pour chasser les agrafes, les rails de guidage décalés en quinconce définissant aussi des surfaces de guidage (78) orientées vers l'intérieur pour guider le coin suivant le trajet de chasse.

10. Appareil jetable pour la pose d'agrafes de sutures linéaires suivant l'une quelconque des revendications 3 à 9, comprenant, en outre, une poche à coin (65) disposée à une extrémité antérieure du dispositif à cartouche pour recevoir le coin avant son déplacement le long du trajet.

11. Appareil jetable pour la pose d'agrafes de sutures linéaires suivant la revendication 10, dans lequel des rails de guidage, à une extrémité antérieure du trajet dans le dispositif à cartouche, comportent des surfaces respectives inclinées vers l'avant (66, 67) qui vont de la poche à coin (65) au trajet afin de guider le coin entre elles lorsqu'il est tiré vers les chasse-agrafes.

12. Appareil jetable pour la pose d'agrafes de sutures linéaires suivant l'une quelconque des revendications 2 à 11, dans lequel chacun des chasse-agrafes (40) comprend des colonnettes de chasse décalées, fourchues (41, 42), reliées à leurs extrémités supérieures, chaque extrémité supérieure présentant une surface de came (45, 46) qui s'incline vers le haut vers un sommet (47) situé entre les colonnettes.

13. Appareil jetable pour la pose d'agrafes de sutures linéaires suivant la revendication 2, dans lequel une des colonnettes (41) de chaque chasse-agrafe est disposée entre deux rails de guidage (70—73) d'un côté du dispositif à cartouche et l'autre colonnette (42) de chaque chasse-agrafe est disposée entre deux autres rails de guidage

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(74—77) de l'autre côté du dispositif à cartouche décalé des deux autres rails de guidage (70—73).

14. Appareil jetable pour la pose d'agrafes de sutures linéaires suivant l'une quelconque des revendications 3 à 13, comprenant une longue nervure de blocage de chasse-agrafes (83) qui s'étend entre des rangées d'agrafes au niveau d'une face inférieure du dispositif à cartouche pour bloquer toute sortie libre des chasse-agrafes (40) du dispositif à cartouche.

15. Appareil jetable pour la pose d'agrafes de sutures linéaires suivant l'une quelconque des revendications 3 à 14, comprenant un couvercle de cartouche (36) disposé au-dessus des canaux de chasse-agrafes et retenant les chasse-agrafes (40), le couvercle définissant une longue fente (96) en ligne avec le trajet destiné à guider le coin (90).

16. Appareil jetable pour la pose d'agrafes de sutures linéaires suivant la revendication 15, dans lequel le coin (90) comprend une lame cunéiforme à bord oblique (91) qui s'étend dans le trajet et un organe de base (92) disposé à coulisser sur le couvercle de cartouche (36).

17. Appareil jetable pour la pose d'agrafes de sutures linéaires suivant la revendication 16, dans lequel le dispositif à cartouche comprend un corps à cartouche (35) contenant des canaux à agrafes, des rails de guidage, des chasse-agrafes et une poche à coin et comprenant, en outre, un boîtier de cartouche (37) enfermant l'organe de base (92) du coin et retenant cet organe de base à coulisser sur le couvercle de cartouche (36).

18. Appareil jetable pour la pose d'agrafes de sutures linéaires suivant l'une quelconque des revendications précédentes, dans lequel un moyen de renforcement flexible (28) attaché le long du dispositif flexible (12) empêche la chasse des agrafes en réaction à un allongement accidentel du dispositif flexible.

19. Appareil jetable pour la pose d'agrafes de sutures linéaires suivant l'une quelconque des revendications 5 à 18, dans lequel le dispositif à

bouton de déclenchement comprend un bouton (18), une poulie à câble (147) attachée au bouton (18) pour tourner avec celui-ci et pouvant intervenir pour tirer le câble (27), lorsqu'elle est tournée initialement dans une direction prédéterminée, et un moyen pour empêcher une rotation initiale de la poulie dans une direction inactive autre que la direction prédéterminée.

20. Appareil jetable pour la pose d'agrafes de sutures linéaires suivant la revendication 19, dans lequel le dispositif à bouton de déclenchement comprend, en outre, une tige filetée (148) qui s'étend au-delà de la poulie afin de tourner avec celle-ci, un écrou (149) sur la tige filetée, des moyens (151) pour empêcher l'écrou de tourner, de sorte que, lorsque le bouton est tourné, l'écrou se déplace le long de la tige, et un premier moyen d'arrêt (147) pour attaquer l'écrou et l'empêcher de se déplacer le long de la tige et pour empêcher la rotation du bouton dans une direction inactive lorsque ce bouton est initialement tourné.

21. Appareil jetable pour la pose d'agrafes de sutures linéaires suivant la revendication 20, comprenant, en outre, une seconde surface d'arrêt pour empêcher une poursuite de la rotation de la tige, de la poulie et du bouton lorsqu'un certain nombre d'agrafes a été posé.

22. Appareil jetable pour la pose d'agrafes de sutures linéaires suivant l'une ou l'autre des revendications 20 ou 21, comprenant, en outre, un dispositif à arrêtoir de sécurité coulissant (165, 168) pour attaquer le bouton, la poulie ou la tige et empêcher sélectivement leur rotation.

23. Appareil jetable pour la pose d'agrafes de sutures linéaires suivant la revendication 22, dans lequel la poulie est pourvue d'un évidement à arrêtoir de sécurité (168) et comprenant, en outre, un arrêtoir de sécurité coulissant (165) dans la poignée, s'étendant dans l'évidement à arrêtoir de sécurité dans une position de sécurité empêchant la rotation du bouton et pouvant être retiré par coulisser de l'évidement pour permettre la rotation du bouton.

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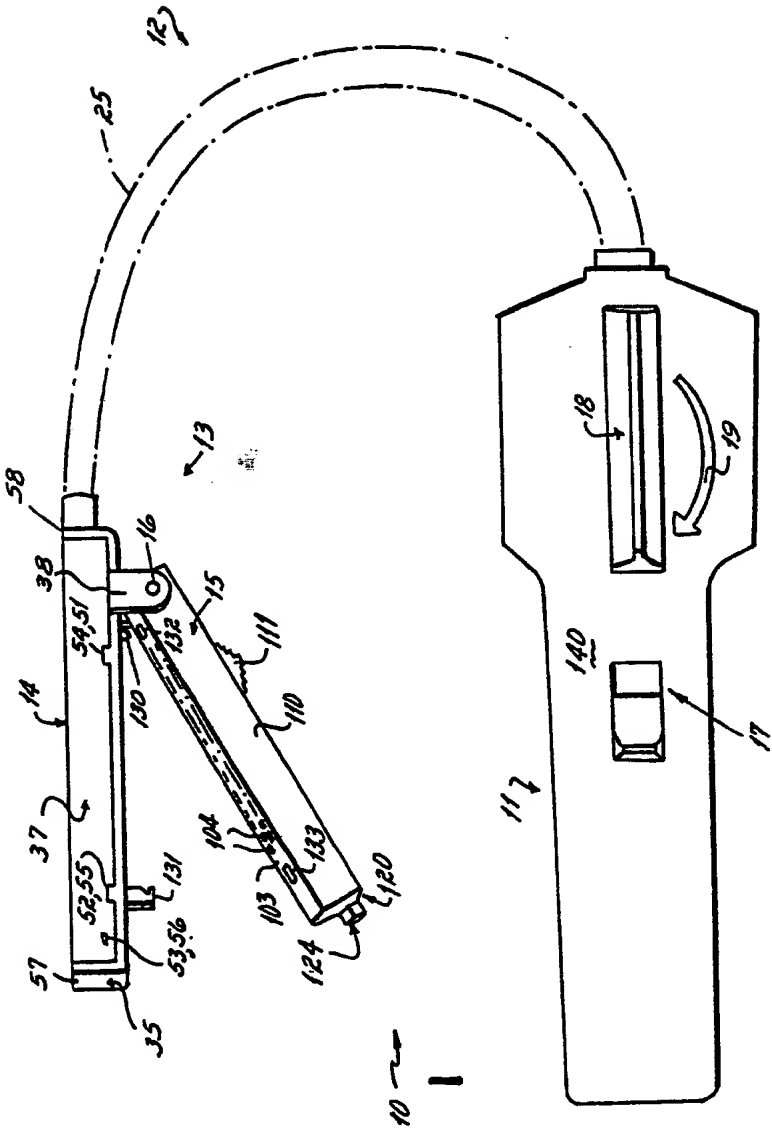
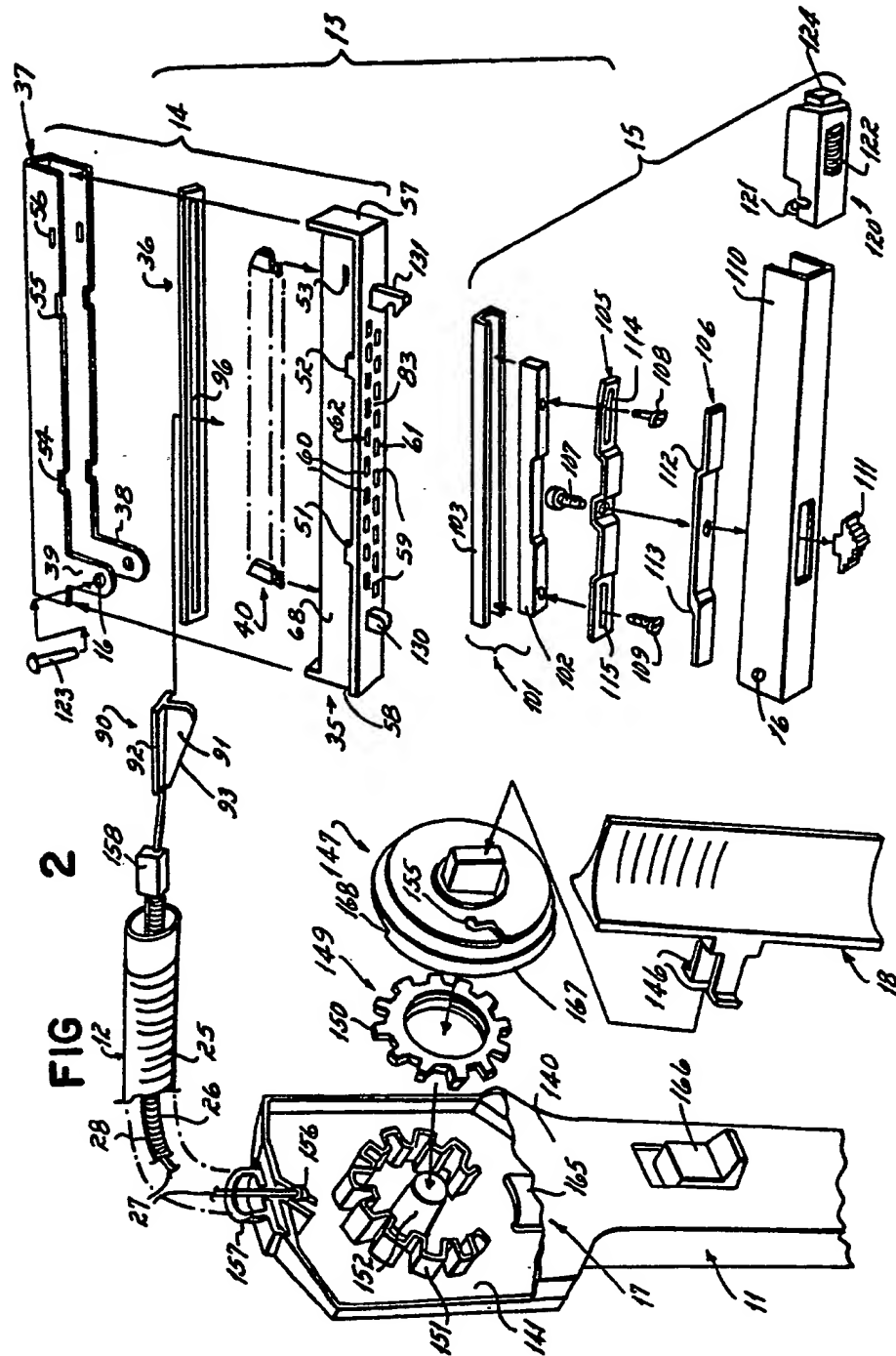


FIG 1

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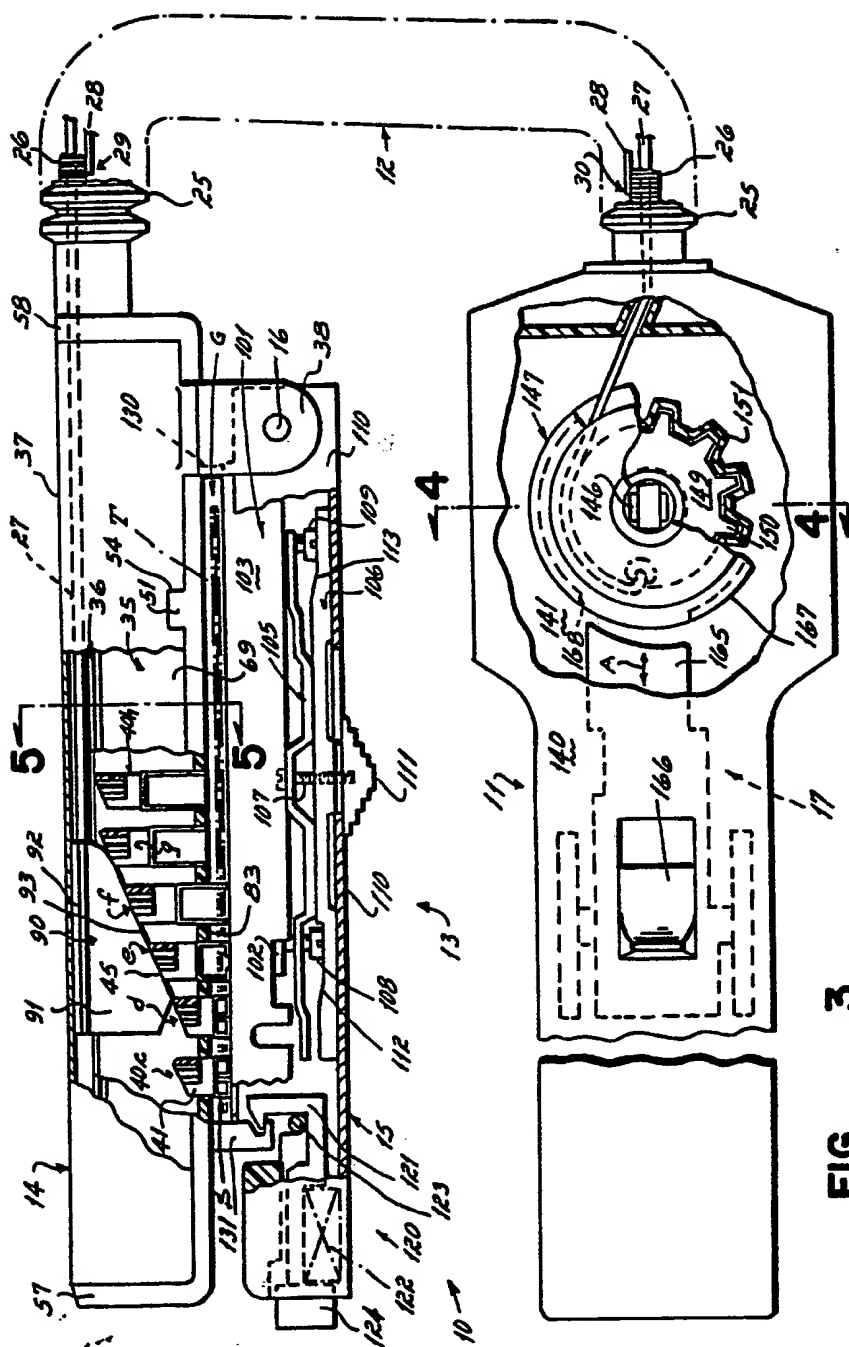


FIG 3

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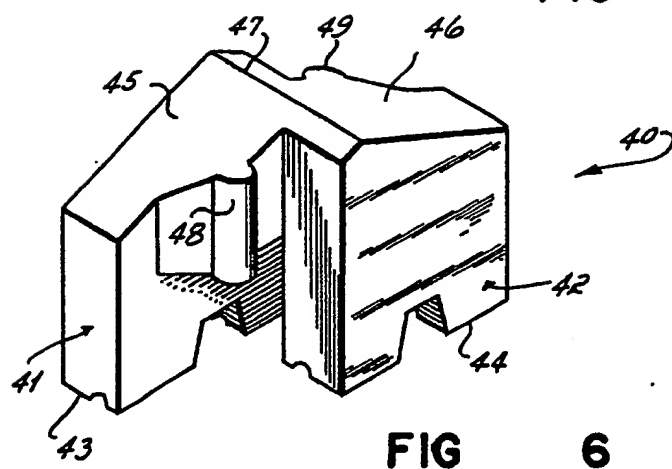
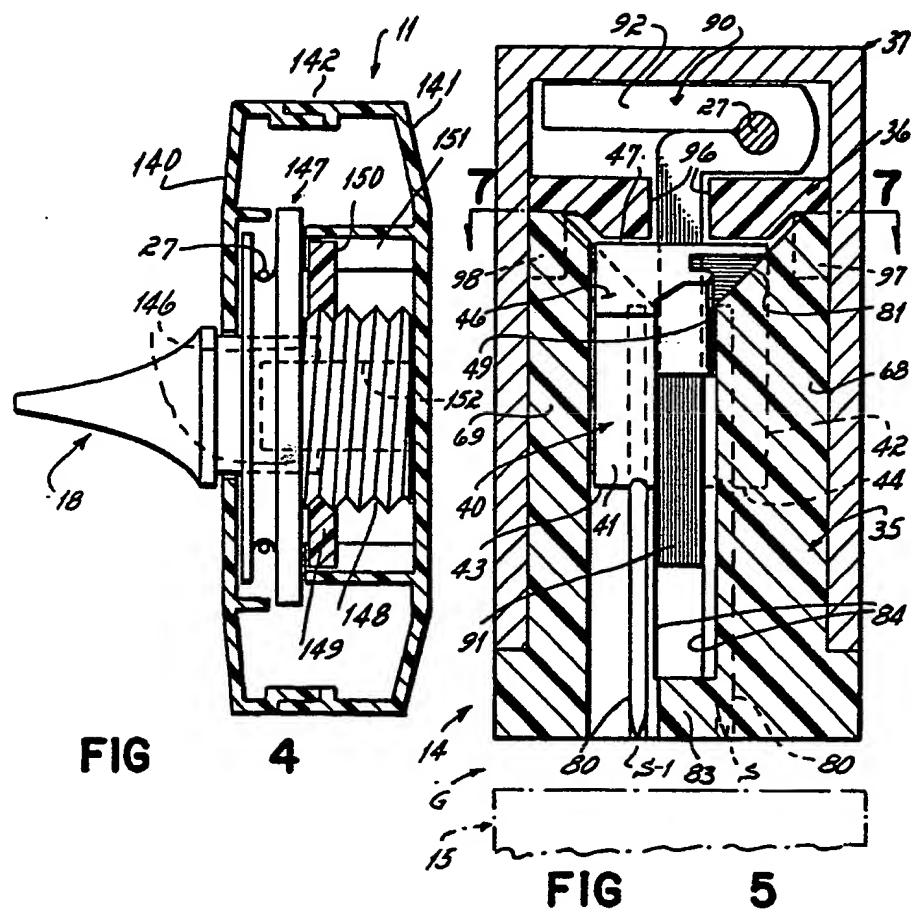


FIG. 7 and FIG. 8 are cross-sectional views of a multi-ported valve assembly. FIG. 7 is a longitudinal section showing a housing 14 with a central bore 27. A valve member 37 is positioned within the bore, controlled by a stem 36 and a handle 35. The valve member has a series of ports 38, 39, 40, 41, 42, 43, 44, 45, 46, 47, 48, 49, 50, 51, 52, 53, 54, 55, 56, 57, 58, 59, 60, 61, 62, 63, 64, 65, 66, 67, 68, 69, 70, 71, 72, 73, 74, 75, 76, 77, 78, 79, 80, 81, 82, 83, 84, 85, 86, 87, 88, 89, 90, 91, 92, 93, 94, 95, 96, 97, 98, 99, 100. FIG. 8 is a transverse section showing the valve member 37 in a closed position, blocking the central bore 27. The valve member has a series of ports 38, 39, 40, 41, 42, 43, 44, 45, 46, 47, 48, 49, 50, 51, 52, 53, 54, 55, 56, 57, 58, 59, 60, 61, 62, 63, 64, 65, 66, 67, 68, 69, 70, 71, 72, 73, 74, 75, 76, 77, 78, 79, 80, 81, 82, 83, 84, 85, 86, 87, 88, 89, 90, 91, 92, 93, 94, 95, 96, 97, 98, 99, 100.

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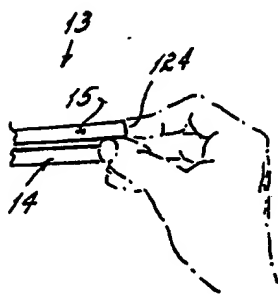


FIG 9

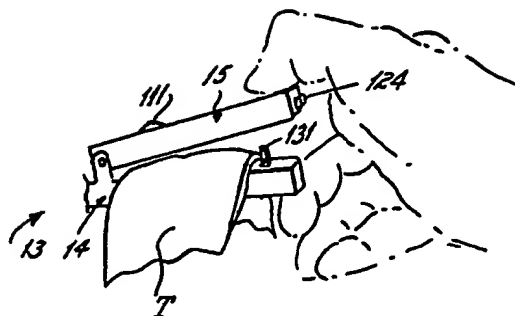


FIG 10

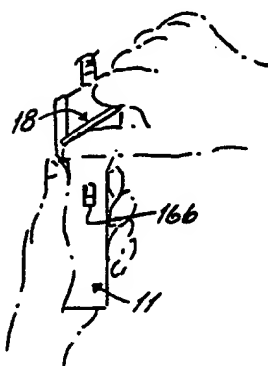


FIG 11

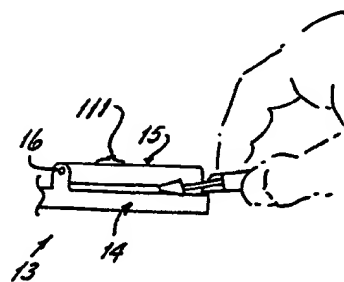


FIG 12

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